CLAIMS

What is claimed is:

1. A nanocomposite resist comprising:
a nanoparticle component; and
a polymer component.

2. The nanocomposite resist of Claim 1, wherein the nanoparticle component comprises a boride, carbide, silicide, nitride, phosphide, arsenide, oxide, sulfide, selenide, telluride, fluoride, chloride, bromide, iodide, or combinations thereof.

3. The nanocomposite resist of Claim 1, wherein the polymer component comprises a polymer that undergoes chain scission upon exposure to electron beam irradiation.

4. The nanocomposite resist of Claim 1, wherein the polymer component comprises poly(α-chloroacrylate-*co*-α-methyl styrene), poly(2,2,2-trifluoroethyl-α-chloroacrylate), poly(methyl methacrylate), poly(butene sulfone), polysilanes, polyacetals, or combinations thereof.

5. The nanocomposite resist of Claim 1, wherein the nanoparticle component comprises a nanoparticle having an average diameter less than about 100 nanometers.

6. The nanocomposite resist of Claim 5, wherein the nanoparticle has an average diameter less than about 10 nanometers.

7. The nanocomposite resist of Claim 6, wherein the nanoparticle has an average diameter less than about 2 nanometers.

8. The nanocomposite resist of Claim 1, wherein the nanoparticle component comprises an oxide of silicon, aluminum, titanium, zirconium, iron, antimony, tin, cerium, barium, manganese, vanadium, chromium, lead, copper, indium, yttrium, zinc, mixed oxides thereof, or combinations thereof.

9. The nanocomposite resist of Claim 1, wherein the nanoparticle component comprises a polyhedral oligosilsesquioxane.

10. The nanocomposite resist of Claim 9, wherein the polyhedral oligosilsesquioxane comprises a compound of formula $Si_8O_{12}(OR)_8$, $Si_8O_{12}R_8$, $Si_{12}O_{18}(OR)_{12}$, or $Si_{12}O_{18}R_{12}$, wherein R is selected from alkyl, substituted alkyl, cycloalkyl, substituted cycloalkyl, silyl, substituted silyl, aryl, substituted aryl, aralkyl, substituted aralkyl, alkenyl, or substituted alkenyl.

11. The nanocomposite resist of Claim 9, wherein the polymer component comprises poly(α-chloroacrylate-*co*-α-methyl styrene).

12. The nanocomposite resist of Claim 1, wherein the nanoparticle component is present in the resist from about 1% to about 50% by weight.

13. The nanocomposite resist of Claim 1, wherein the resist has a glass transition temperature of at least about 160°C.

14. A lithographic process wherein the lithographic recording medium comprises the nanocomposite resist of Claim 1.

15. The lithographic process of Claim 14, wherein the nanoparticle component comprises an oxide of silicon, aluminum, titanium, zirconium, iron, antimony, tin, cerium, barium, manganese, vanadium, chromium, lead, copper, indium, yttrium, zinc, mixed oxides thereof, or combinations thereof.

16. The lithographic process of Claim 14, wherein the nanoparticle component comprises a polyhedral oligosilsesquioxane.

17. The lithographic process of Claim 14, wherein the polymer component comprises poly(α-chloroacrylate-*co*-α-methyl styrene), poly(2,2,2-trifluoroethyl-α-chloroacrylate), poly(methyl methacrylate), poly(butene sulfone), polysilanes, polyacetals, or combinations thereof.

18. The lithographic process of Claim 14, wherein the nanocomposite resist comprises poly(α-chloroacrylate-*co*-α-methyl styrene) and the nanoparticle component comprises a polyhedral oligosilsesquioxane.

19. An integrated circuit prepared by the lithographic process of Claim 14.

20. An electron beam lithographic process wherein the lithographic recording medium comprises the nanoparticle resist of Claim 1.

21. An ion beam lithographic process wherein the lithographic recording medium comprises the nanoparticle resist of Claim 1.

22. A polymeric chemically amplified resist comprising:
a methacrylate component; and
a polyhedral oligosilsequioxane component.

23. The polymeric chemically amplified resist of Claim 22, wherein the methacrylate component comprises methyl methacrylate, t-butyl methacrylate, methacrylic acid, or combinations thereof.

24. The polymeric chemically amplified resist of Claim 22, wherein the polyhedral oligosilsequioxane component comprises 3-(3,5,7,9,11,13,15-heptacyclopentylpentacyclo-[9.5.1.1^{3,9}.1^{5,15}.1^{7,13}]octasiloxane-1-yl)propyl methacrylate; 3-[(3,5,7,9,11,13,15-heptacyclopentylpentacyclo-[9.5.1.1^{3,9}.1^{5,15}.1^{7,13}]octasiloxan-1-yloxy)dimethylsilyl]propyl methacrylate; 1,3,5,7,9,11,13-heptacyclopentyl-15vinylpentacyclo-[9.5.1.1^{3,9}.1^{5,15}.1^{7,13}]-octasiloxane, or combinations thereof.

25. The polymeric chemically amplified resist of Claim 22, wherein the polyhedral oligosilsequioxane component is present from about 1% to about 40% by weight in the polymer.

26. The polymeric chemically amplified resist of Claim 22, wherein the polymeric resist has a glass transition temperature greater than about 165°C.

27. The polymeric chemically amplified resist of Claim 22, wherein the polymeric resist has a weight-average molecular weight greater than about 100,000 g/mol.

28. The polymeric chemically amplified resist of Claim 22, wherein the polymer has a polydispersity index between 1 and about 2.

29. A polymeric chemically amplified resist comprising methyl methacrylate, t-butyl methacrylate, methacrylic acid, and 3-(3,5,7,9,11,13,15-heptacyclopentylpentacyclo-[9.5.1.1^{3,9}.1^{5,15}.1^{7,13}]octasiloxane-1-yl)propyl methacrylate.

30. A lithographic process wherein the lithographic recording medium comprises the polymeric chemically amplified resist of Claim 22.

31. The lithographic process of Claim 30, wherein the methacrylate component comprises methyl methacrylate, t-butyl methacrylate, methacrylic acid, or combinations thereof.

32. The lithographic process of Claim 30, wherein the polyhedral oligosilsequioxane component comprises 3-(3,5,7,9,11,13,15-heptacyclopentylpentacyclo-[9.5.1.1^{3,9}.1^{5,15}.1^{7,13}]octasiloxane-1-yl)propyl methacrylate; 3-[(3,5,7,9,11,13,15-heptacyclopentylpentacyclo-[9.5.1.1^{3,9}.1^{5,15}.1^{7,13}]octasiloxan-1-yloxy)dimethylsilyl]propyl methacrylate; 1,3,5,7,9,11,13-heptacyclopentyl-15vinylpentacyclo-[9.5.1.1^{3,9}.1^{5,15}.1^{7,13}]octasiloxane, or combinations thereof.

33. The lithographic process of Claim 30, wherein the polymeric chemically amplified resist comprises methyl methacrylate, t-butyl methacrylate, methacrylic acid, and 3-(3,5,7,9,11,13,15-heptacyclopentylpentacyclo-[9.5.1.1^{3,9}.1^{5,15}.1^{7,13}]octasiloxane-1-yl)propyl methacrylate.

34. An integrated circuit prepared by the lithographic process of Claim 30.

35. An electron beam lithographic process wherein the lithographic recording medium comprises the polymeric chemically amplified resist of Claim 22.

36. An ion beam lithographic process wherein the lithographic recording medium comprises the polymeric chemically amplified resist of Claim 22.

37. An X-ray lithographic process wherein the lithographic recording medium comprises the polymeric chemically amplified resist of Claim 22.

38. A polymeric chemically amplified resist comprising:
a methacrylate component;
a photoacid generating component.

39. The polymeric chemically amplified resist of Claim 38, wherein the methacrylate component comprises methyl methacrylate, t-butyl methacrylate, methacrylic acid, or combinations thereof.

40. The polymeric chemically amplified resist of Claim 38 further comprising a dissolution promoter.

41. The polymeric chemically amplified resist of Claim 40 wherein the dissolution promoter comprises itaconic anhydride.

42. The polymeric chemically amplified resist of Claim 38, wherein the photoacid generating component comprises a sulfonium compound, an ionium compound, or combinations thereof.

43. The polymeric chemically amplified resist of Claim 38, wherein the photoacid generating component comprises [*p*-$CH_2=C(CH_3)C(O)$-$OC_6H_4SMe_2$]OSO_2CF_3.

44. The polymeric chemically amplified resist of Claim 38, further comprising a polyhedral oligosilsequioxane component.

45. The polymeric chemically amplified resist of Claim 44, wherein the polyhedral oligosilsequioxane component comprises 3-(3,5,7,9,11,13,15-heptacyclopentylpentacyclo-[9.5.1.1^{3,9}.1^{5,15}.1^{7,13}]octasiloxane-1-yl)propyl methacrylate; 3-[(3,5,7,9,11,13,15-heptacyclopentylpentacyclo-[9.5.1.1^{3,9}.1^{5,15}.1^{7,13}]octasiloxan-1-yloxy)dimethylsilyl]propyl methacrylate; 1,3,5,7,9,11,13-heptacyclopentyl-15vinylpentacyclo-[9.5.1.1^{3,9}.1^{5,15}.1^{7,13}]-octasiloxane, or combinations thereof.

46. The polymeric chemically amplified resist of Claim 44, wherein the polyhedral oligosilsequioxane component is present from about 1% to about 35% by weight in the polymer.

47. The polymeric chemically amplified resist of Claim 38, wherein the polymer has a weight-average molecular weight between 20,000 to 100,000 g/mol.

48. The polymeric chemically amplified resist of Claim 38, wherein the polymer has a polydispersity index between 1 and about 2.

49. A polymeric chemically amplified resist comprising methyl methacrylate, t-butyl methacrylate, methacrylic acid, 3-(3,5,7,9,11,13,15-heptacyclopentylpentacyclo-[9.5.1.1^{3,9}.1^{5,15}.1^{7,13}]octasiloxane-1-yl)propyl methacrylate, and [*p*-CH_2=$C(CH_3)C(O)OC_6H_4SMe_2$]OSO_2CF_3.

50. The polymeric chemically amplified resist of Claim 49, further comprising itaconic anhydride.

51. A lithographic process wherein the lithographic recording medium comprises the polymeric chemically amplified resist of Claim 38.

52. The lithographic process of Claim 51, wherein the methacrylate component comprises methyl methacrylate, t-butyl methacrylate, methacrylic acid, or combinations thereof.

53. The lithographic process of Claim 51, wherein the polymeric chemically amplified resist further comprises a dissolution promoter.

54. The lithographic process of Claim 53, wherein the dissolution promoter comprises itaconic anhydride.

55. The lithographic process of Claim 51, wherein the photoacid generating component comprises a sulfonium compound, an ionium compound, or combinations thereof.

56. The lithographic process of Claim 51, wherein the polyhedral oligosilsequioxane component comprises 3-(3,5,7,9,11,13,15-heptacyclopentylpentacyclo-[9.5.1.1^{3,9}.1^{5,15}.1^{7,13}]octasiloxane-1-yl)propyl methacrylate; 3-[(3,5,7,9,11,13,15-heptacyclopentylpentacyclo-[9.5.1.1^{3,9}.1^{5,15}.1^{7,13}]octasiloxan-1-yloxy)dimethylsilyl]propyl methacrylate; 1,3,5,7,9,11,13-heptacyclopentyl-15vinylpentacyclo-[9.5.1.1^{3,9}.1^{5,15}.1^{7,13}]octasiloxane, or combinations thereof.

57. An integrated circuit prepared by the lithographic process of Claim 51.

58. An extreme ultraviolet lithographic process wherein the lithographic recording medium comprises the polymeric chemically amplified resist of Claim 38.

59. An X-ray lithographic process wherein the lithographic recording medium comprises the polymeric chemically amplified resist of Claim 38.

60. A polymeric lithographic resist comprising a photoacid generating component.

61. The polymeric lithographic resist of Claim 60, wherein the photoacid generating component comprises a sulfonium compound, an ionium compound, or a combination thereof.

62. The polymeric lithographic resist of Claim 60, wherein the photoacid generating component comprises [*p*-CH_2=$C(CH_3)C(O)$-$OC_6H_4SMe_2$]OSO_2CF_3.

63. A lithographic process wherein the lithographic recording medium comprises the polymeric resist of Claim 60.

64. An integrated circuit prepared by the lithographic process of Claim 63.

65. A polymeric resist comprising:
a polyhedral oligosilsequioxane disilanol component; and
a polyacetal component.

66. The polymeric resist of Claim 65, wherein the polyhedral oligosilsequioxane disilanol component comprises disilanol cyclopentyl POSS (Si_8O_{11}(*c*-C_5H_9)$_8$$(OH)_2$), disilanol isobutyl POSS (Si_8O_{11}(*i*-C_4H_9)$_8$$(OH)_2$), or dimethylphenyldisilanol cyclopentyl POSS (Si_8O_9(*c*-C_5H_9)$_7$$(OSiMe_2Ph)(OH)_2$), or a combination thereof.

67. The polymeric resist of Claim 65, wherein the polyacetal component comprises a polymer of a halogen-substituted ketone or aldehyde.

68. The polymeric resist of Claim 65, wherein the polyacetal component comprises a polymer of hexafluoroacetone, trifluoroacetone, hexachloroacetone, trichloroacetone, trifluoroacetaldehyde, trichloroacetaldehyde, thiocarbonylfluoride, hexafluorothioacetone, mixtures thereof, and derivatives thereof.

69. A lithographic process wherein the lithographic recording medium comprises the polymeric resist of Claim 65.

70. The lithographic process of Claim 69, wherein the lithographic process is a 157 nm projection optical lithographic process.

71. An integrated circuit prepared by the lithographic process of Claim 69.